

WHAT IS CLAIMED IS:

1. A direct-to-digital holography system,  
comprising:  
an illumination lens operable to focus a reference  
5 beam;

a beam splitter optically coupled to the  
illumination lens by the reference beam; and

a reference mirror located at a waist of the  
reference beam, the reference beam mirror operable to  
10 eliminate a reference objective.

2. The system of Claim 1, wherein the beam  
splitter comprises a cube beam splitter operable to  
eliminate first order reflections.

15 3. The system of Claim 1, further comprising a  
quarter-wave plate optically coupled between the beam  
splitter and the reference mirror.

20 4. The system of Claim 1, wherein the reference  
beam comprises a Gaussian beam.

5. The system of Claim 1, wherein the reference  
mirror comprises a flat mirror.

25 6. The system of Claim 1, further comprising the  
reference mirror operable to maintain optical symmetry of  
a reference arm and a target arm.

7. The system of Claim 1, further comprising the reference mirror operable to form a first wavefront substantially similar to a second wavefront formed by the reference objective.

8. A method for acquiring a complex image in a direct-to-digital holography system, comprising:

focusing a reference beam with an illumination lens, the reference beam including a waist;

5 transmitting at least a portion of the reference beam through a beam splitter; and

reflecting the portion of the reference beam from a reference mirror located at the waist of the reference beam.

10

9. The method of Claim 8, further comprising the reference mirror operable to replace a reference objective.

15 10. The method of Claim 9, further comprising forming a combined wavefront at a digital recorder, the wavefront substantially similar to a wavefront produced by the reference objective.

20 11. The method of Claim 8, further comprising the reference mirror operable to maintain optical symmetry of a reference arm and a target arm.

25 12. The method of Claim 8, wherein the reference beam comprises a Gaussian beam.

13. A direct-to-digital holography system,  
comprising:

a laser operable to produce a laser beam;

a half-wave plate optically coupled to the laser,

5 the half-wave plate operable to rotate the laser beam  
between a first polarization and a second polarization;

a beam splitter located proximate the half-wave  
plate, the beam splitter operable to split the laser beam  
into a reference beam associated with a reference arm and  
10 a target beam associated with a target arm such that the  
reference beam includes the first polarization and the  
target beam includes the second polarization;

a target half-wave plate optically coupled to the  
beam splitter by the target beam; and

15 a reference half-wave plate optically coupled to the  
beam splitter by the reference beam;

the target and reference half-wave plates operable  
to respectively rotate the target and reference beams in  
order to match polarizations of the target and reference  
20 arms.

14. The system of Claim 1, wherein the beam  
splitter comprises a cube beam splitter operable to  
eliminate first order reflections.

25

15. The system of Claim 1, wherein the laser beam  
comprises a linearly polarized beam.

16. The system of Claim 1, further comprising the  
30 target and reference half-wave plates operable to  
respectively rotate the target and reference beams to  
match power in the target and reference arms.

17. The system of Claim 13, further comprising a  
beam combiner optically coupled to outputs of the target  
and reference arms, the beam combiner operable to combine  
5 the rotated target and reference beams to generate a  
complex image.

18. A method for acquiring a complex image in a direct-to-digital holography system, comprising:

rotating a laser beam such that the laser beam includes either a first polarization or a second  
5 polarization;

splitting the rotated beam into a target beam associated with a target arm and a reference beam associated with a reference arm, the target beam including the first polarization and the reference beam  
10 including the second polarization; and

rotating either the target beam or the reference beam in order to obtain either the first polarization or the second polarization at beam combiner located proximate outputs of the target and reference arms.  
15

19. The method of Claim 18, further comprising matching power in the target and reference arms.

20. The method of Claim 18, further comprising the  
20 beam combiner operable to combine the rotated reference and target beams at a digital recorder in order to create a complex image.

21. A direct-to-digital holography system,  
comprising:

a laser operable to generate a laser beam;  
a lens operable to focus the laser beam; and  
5 a tilting mirror optically coupled between the laser  
and the lens at a back focus point of the lens, the  
tilting mirror operable to pivot in order to reflect the  
laser beam towards the lens at an off-axis angle.

10 22. The system of Claim 21, wherein the laser beam  
comprises a substantially collimated beam.

23. The system of Claim 21, wherein the tilting  
mirror comprises a gimbal mirror.

15 24. The system of Claim 21, further comprising an  
objective optically coupled to the lens by the laser  
beam, the objective operable to illuminate a target with  
the off-axis angle laser beam.

20 25. The system of Claim 21, further comprising the  
tilting mirror operable to increase a resolution of a  
complex image acquired by the system.

26. A method for acquiring a complex image in a direct-to-digital holography system, comprising:

reflecting a laser beam from a tilting mirror located at a back focal point of an illumination lens,  
5 the tilting mirror operable to pivot about a center in order to create an off-axis laser beam;

passing the off-axis laser beam through the illumination lens; and

illuminating a target with the off-axis laser beam  
10 in order to generate an image including high frequency components.

27. The method of Claim 26, wherein the laser beam comprises a substantially collimated beam.

15

28. The method of Claim 26, wherein the tilting mirror comprises a gimbal mirror.



29. A direct-to-digital holography system,  
comprising:

a laser operable to generate a laser beam; and  
a cube beam splitter optically coupled to the laser,  
5 the cube beam splitter operable to eliminate first order  
reflections.

30. The system of Claim 29, wherein the cube beam  
splitter comprises at least four sides including an anti-  
10 reflective coating.

31. The system of Claim 29, further comprising a  
ghost beam generated if a transmitted portion of the  
laser beam reflects off at least two sides of the cube  
15 beam splitter, the ghost beam including a second order  
reflection.

32. The system of Claim 29, further comprising the  
cube beam splitter operable to reduce interference  
20 patterns in a complex image captured by a digital  
recorder.